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AUDIT RESPONSES: RESPONSES MAINTAINED BY ACCESS TO EXISTING SELF OR COACTOR SCORES DURING NON-SOCIAL, PARALLEL WORK, AND COOPERATION PROCEDURES[1]

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Human subjects, mostly between 11 and 16 yr old, matched to sample for points that were exchangeable for money. An audit response was defined as a response maintained by allowing a subject access to an existing score on his own (self audit) or a coactor's (coactor audit) performance. In Experiment I, changes from non-social procedures (no coactor) to social procedures (coactor present) increased self and coactor audits. Since both types of audits occurred at about the same rates during cooperation and parallel work procedures, the increases did not depend on the subjects' response interactions. Although Experiment I did not demonstrate that subjects were comparing scores, the frequent occurrence of each kind of audit within a brief time period (interpersonal audit) did indicate that it was reinforcing to have both scores at the same time. These interpersonal audits suggested that the coactor's score increased self audits during social procedures. Experiment II supported this notion: relative to a non-social procedure, self audits increased more during a parallel work procedure when the coactor's score was accessible than when it was not accessible. Thus, increases in other behaviors that occur in the presence of a coactor, *i.e.*, social facilitation, may also result from or be increased by providing a coactor's score.

Humans frequently emit responses that produce scores on their own or another person's performance. For example, in a recent study of cooperation, subjects frequently asked partners how many points were earned (Hake and Vukelich, 1973). Similar responses can be observed in many human situations, particularly those involving school, work, and games. When a response is strengthened or maintained by allowing access to an existing score, the score will be defined as a reinforcer, the response an audit response, and the entire process an audit. An audit response merely allows access to an existing score. The score itself depends upon another response, not the audit response. When an audit response allows access to a score on the subject's own performance, the audit will be designated as a self audit; when an audit response allows access to another person's score, the audit will be designated as a coactor audit.

A number of studies have allowed access to scores on performance to determine the effect of these scores upon subsequent performance, but few, if any, have measured audit responses. For example, several studies investigated the effects of access to scores upon subsequent educational performance (*e.g.*, Krumboltz and Weisman, 1962; Boersma, 1966; Sassenrath and Yonge, 1969), self-reward behaviors (*e.g.*, Bandura and Whalen, 1966; Mischel, Coates, and Raskoff, 1968; Masters, 1968) and cooperative behaviors (*e.g.*, McClintock and McNeel, 1966; Marwell, Ratcliff, and Schmitt, 1969; Schmitt and Marwell, 1971; Voissem and Sistrunk, 1971). However, in these studies, scores typically were either (1) provided by the experimenter rather than dependent upon the subject, or (2) produced by responses that had consequences in addition to producing a score, *e.g.*, the response that allowed access to the score also completed a task. As a result, little is known about how often subjects make self- and coactor audit responses, when they make them, or the variables that affect such responses.

The first objective of Experiment I was to provide an independent and objective mea-

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sure of audit responses in order to determine the types of audits (self and coactor) that occur in social situations (coactor present), how often they occur, and when they occur. Audit responses were arranged to be independent of other responses and other reinforcers: they were not necessary (1) to produce points, (2) to complete the task for which the points were given, or (3) to learn whether or not task responses were correct.

The second objective of Experiment I was to evaluate factors in social situations that might influence audit responses. One question was whether social interactions such as cooperation increase coactor and/or self audits above the levels found with non-social procedures (no coactor). If so, are the increases due to the nature of the procedure, *e.g.*, the interaction between the responses of the subjects in a cooperation procedure? Or are the increases due to the mere addition of a coactor into the situation and, as a result, not limited to a specific social procedure? These questions were studied by comparing rates of self and coactor audits during (1) a non-social procedure, (2) a cooperation procedure, and (3) a parallel-work procedure in which there were no interactions between the responses of the subjects.

Experiment II evaluated one aspect of a coactor, the availability of a coactor's score, that might influence the rate of self-audit responses.

EXPERIMENT I

Subjects

Four pairs of subjects (Subjects 1 to 8) were 14 to 16-yr old male students from junior and senior high schools who volunteered to participate in the experiment. The last pair (Subjects 9 and 10) consisted of two hospital residents, a 27-yr-old female and a 32-yr-old male, both of normal intelligence.

Each subject participated in two 20-min sessions each day, four to five days per week for a total of approximately 20 sessions. For the student subjects, sessions were conducted during free school periods or after school hours with transportation provided to and from the laboratory. Earnings from the experiment and a 50-cent bonus per day for attending five consecutive days were paid weekly. A subject could earn more than, less than, or as much as his coactor in a given session, but when the scores were totalled for an entire week, each member of a pair usually earned about the same amount. To minimize the possibility that the subjects might learn this, each member of a pair was paid on a different day and, as a result, for a different series of sessions.

Apparatus

The apparatus was essentially the same as in Hake and Vukelich (1973). Each member of a pair had a matching-to-sample apparatus that consisted of a panel for producing the sample stimuli (left side of Figure 1) and a panel for matching the sample stimuli (right side of Figure 1). The sample panel and matching panel of each subject were color coded: those of Subject A were green and those of Subject B were brown. The matching panels of the two subjects were always 4-m apart, but each subject's sample panel could be placed at different distances from his matching panel.

Each matching panel, 42-cm (16.5 in.) wide by 31-cm (12.25 in.) high, was fastened to a box on a table (Figure 1). On each matching panel from top to bottom was a 2.5-cm (1 in.) diameter opening through which the point value of each problem was projected (magnitude-of-reinforcement stimulus), a 0.4-cm diameter light that flashed after a correct matching response on that matching panel (feedback stimulus), three pairs of 1.5-cm (0.75 in.) diameter buttons with a letter corresponding to each button (matching-response buttons), and a 1.5-cm diameter button that was to be depressed before talking (conference button). The two counters on the right side of the panel were labelled "me" (self-audit counter) and "other person" (coactor-audit counter). Both counters were covered with one-way glass. Pressing the button to the left of either counter illuminated the area behind the one-way glass on that counter, thereby making the glass transparent and showing the point score on that counter. A given counter remained illuminated for as long as the subject pressed the appropriate button (Subjects 1 to 8) or for 2 sec (Subjects 9 and 10).

The sample panel, 23-cm (9 in.) wide by 18-cm (7 in.) high, was fastened to the top of a 92-cm-high (36 in.) stand, thereby putting the sample panel at eye-level of the seated subject. Illumination of a 1.5-cm diameter light (sample-operative stimulus) on top of the sample panel indicated which of the two sam-

ple panels was operative. The face of the sample panel contained three, 2.5-cm diameter openings through which the sample stimuli were projected, and a 1.5-cm diameter button (sample-producing button) that, when pressed, presented one of two letters for 1 sec through each of the stimulus openings. The letters were P or T, K or H, V or R. The letter combinations were randomized on two, 33-pole steppers that alternated every 2 min so that the letter combinations were presented in different orders. The point values for the problems and which sample panel was operative on each problem were also randomized on 33-pole steppers so that they were presented in different orders.

The experimental room, approximately 6 by 7 by 2 m, was adequately ventilated by an air conditioner, which also masked noises outside the room. A closed-circuit television camera and a microphone, in full view of the subjects, permitted continuous visual and auditory monitoring. A voice-operated relay in the room was also in full view. The electromechanical scheduling and recording equipment, the video monitor, and the speaker were in an adjacent room.

Procedure

The matching-to-sample task for all procedures. The matching-to-sample apparatuses worked as follows. The magnitude-of-reinforcement stimulus on both matching panels presented the 1-, 2-, or 3-cent point value of the next problem. Approximately 0.5 sec later, the sample-operative stimulus on top of one of the sample panels was illuminated so that the subject at the corresponding matching panel would receive the number of points assigned to the problem if he worked it correctly. The mixed orders of point values and who was presented a given problem resulted in an uneven accumulation of points, even though both subjects earned about the same amount over sessions.

The sample-operative stimulus was illuminated for 8 sec or until the sample stimuli were produced and the matching response completed. A correct matching response was followed by the feedback stimulus, and by the recording of the appropriate number of points on the self-audit counter of that matching panel and on the coactor-audit counter of the other matching panel. There were 7.5 sec between the end of one problem and the start of the next one: the magnitude-of-reinforcement stimulus for the next problem came on 7.5 sec after the previous matching response was completed or, if the problem was not completed, 7.5 sec after the 8 sec allotted to work the problem had elapsed.

Non-social procedures. Two non-social procedures differed only with respect to the location of the subject's sample panel. During the first procedure, non-social walk (A_1), each subject's sample panel was 4-m away from his matching panel next to the other matching panel, so that the subject had to walk to his sample panel in order to produce his sample stimuli.

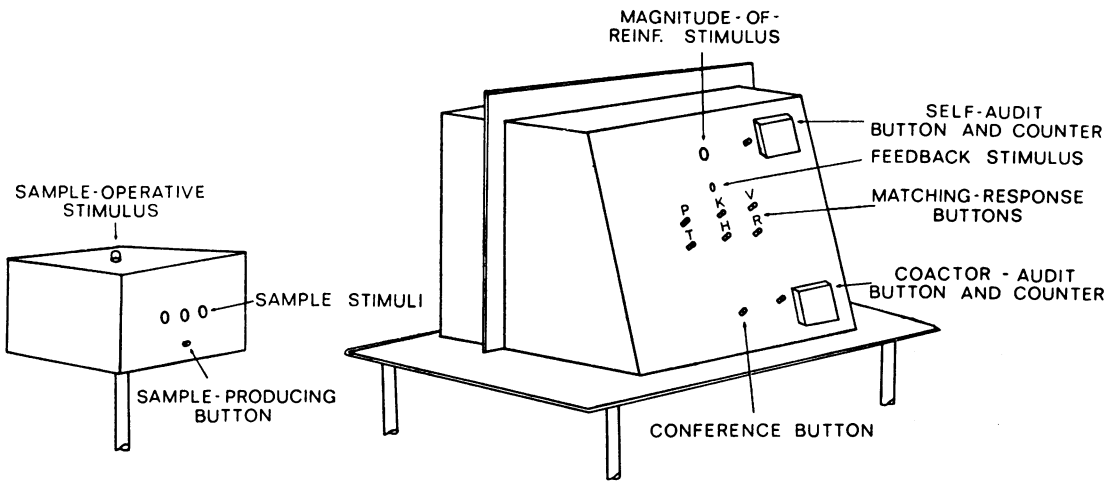

Fig. 1. Diagram of the sample panel (left) and the matching response panel (right) of one subject.

In the second procedure, non-social seated (A_2), each subject's sample panel was next to his matching panel so that he could remain seated and produce his sample stimuli.

Social procedures. There were two social procedures, cooperation and parallel work. During cooperation (B_1), subjects were tested together, but the sample panel of each subject was moved straight ahead 4 m so that each sample panel was next to the other subject's matching panel. Each sample panel still faced the corresponding matching panel so that the subject at a given matching panel could see his sample stimuli if the subject at the other matching panel produced them for him (cooperative response). Hence, if the subjects responded cooperatively, they could remain seated while producing their coactor's sample stimuli and matching their own sample stimuli. Individual responding required subjects to walk 4 m to produce their own sample stimuli and to return to their own matching panel to make their matching responses.

During the parallel work procedure (B_2), each subject's sample panel was next to his matching panel. This arrangement made it easier for subjects to work individually because they could remain seated to produce their own sample stimuli and match them.

Experimental design. The experimental design alternated non-social (A_1 or A_2) and social (B_1 or B_2) procedures with Subjects 2, 3, 4, and 6 tested in a A_1, B_1, A_1, B_2 sequence, and Subjects 1, 5, 7, 8, 9, 10 tested in the same sequence, with the A_2 procedure added at the end.

Subjects were first given three (Subjects 1 to 8) or four (Subjects 9 and 10) sessions under the A_1 procedure to provide a non-social baseline of audits. Subjects were then tested under the cooperation procedure (B_1) until there were eight sessions of cooperative responding. The A_1 procedure was then re-introduced for one session to determine whether or not the changes that had occurred during cooperation were a function of that procedure or some other variable correlated with the passage of time. The parallel work or B_2 procedure was introduced for four sessions to determine whether the changes that occurred during cooperation were the result of the response interactions during cooperation or of some stimulus aspect of the coactor. The second non-social procedure, non-social seated (A_2), was then introduced for two sessions to determine if the changes that occurred during the social procedures could be attributed to the fact that subjects remained seated during the social procedures.

Instructions. During an initial training session, each subject was alone and his sample panel was next to his matching panel (A_2). During the reading of the instructions, the experimenter pointed to the location of the parts of the apparatus that are parenthesized below.

"Please sit down in the chair facing the large green (or brown) box (matching-response panel). This box can be used to work problems. If you work a problem correctly, you will receive points which can later be exchanged for money. Each problem will be worth the number of points that will appear in this circle (magnitude-of-reinforcement stimulus). You can check the total number of points you have at any time by pressing the button (five button presses for Subjects 9 and 10) labelled "me" and looking at the counter (self-audit button and counter). There will be times when another person will also be in the room working problems. You can check the total number of points the other person has at any time by pressing the button (five button presses for Subjects 9 and 10) labelled "other person" (coactor-audit button and counter). Each point will be worth 1¢. You can work the problems in the following way. Shortly after a number appears in this opening (magnitude-of-reinforcement stimulus), the light on top of one of these stands (sample-operative stimulus) will come on. Your box (matching-response panel) is green (or brown) so you can work the problem when the light on top of the green (or brown) stand comes on. Pressing this button (sample-producing button) will produce a letter in each of these three openings (sample stimuli). The three pairs of buttons in front of you (matching-response buttons) indicate which letters may appear in each opening on your stand (sample panel). For example, the first opening can have the letter P or the letter T, the second opening the letter K or the letter H, and the third opening the letter V or the letter R. Your job is to press the buttons (matching-response buttons) that have the same letters that appeared in the openings on your stand. You can push the buttons in any order you wish. When you work a problem correctly, this small light will flash (feedback stimulus) and the number of points that appeared in this opening (magnitude-of-reinforcement stimulus) will be recorded on the "me" counter. There will be a few seconds between problems. During this time all of the lights on your panel and stand will be out and problems can't be worked. Do you have any questions? (Questions were answered by re-reading the relevant part of the instructions.) After I leave the room, the lights on your box will come on and you may begin working."

Each subject was allowed to work until he correctly worked five consecutive problems.

Upon completion of the training session and subsequent sessions, subjects were asked to leave the room while the counters were cleared and a receipt indicating the amount earned for that session was placed face down on each subject's desk.

All subsequent sessions were preceded by the following instructions:

> "Remember your box is green (or brown) so you can watch the letters on the green (or brown) stand. You can work the problems any way you want except you cannot move your panel or stand. Do you have any questions? After I leave the room the lights on your panel will come on and you may begin."

Instructions for the sessions under the social procedures also contained the following paragraph concerning the conference button.

> "If you want to talk with the other person, press the button labelled conference (conference button) before you start talking and press it for as long as you talk. Pressing this button interrupts the problems only for as long as the button is pressed. If you talk with the other person without pressing the button, this box (voice-operated relay) will detect your voice and you will not be able to work problems for 2 min. Remember, if you want to talk, you can, but always press your conference button first."

Talking was actually monitored by the microphone rather than the voice-operated relay. Only on three occasions for one pair (Subjects 7 and 8) did subjects talk without pressing the conference button.

Data analysis. Although session times were constant, and the number of problems per session was scheduled to be the same under each procedure, the number of problems per session could vary. The biggest source of variability was the fact that a subject could work a problem in less time (usually 3 to 4 sec) than the total time allotted (8 sec), but under the non-social procedures where there was no coactor, coactor problems necessarily took the total 8 sec. Because coactor problems lasted longer under the non-social procedures, there were fewer problems per session under those procedures. Subjects averaged 36.3 problems per session under the non-social procedures compared to 47.7 under the social procedures. This difference was taken into account by presenting the data in terms of audits per problem rather than audits per unit of time.

Occasionally, subjects illuminated the same audit counter several times in rapid succession. Such counter illuminations did not appear to be maintained by the score, since there was too little time between them for the score to change. For this reason, a counter illumination was designated as a burst and not counted if a counter illumination of that same type had been counted as an audit less than 5 sec previously. Hence, each type of audit had a maximum rate of one every 5 sec or 240 per session.

Results

The major finding was that the subjects produced more self audits under the social procedures than under the non-social procedures. Figure 2 shows a session-by-session plot of self audits per problem, and Table 1 gives the mean self-audits per problem for all sessions under each procedure. With the exception of Subjects 7 and 10, self audits increased from the initial non-social procedure (A_1) to cooperation and then decreased upon reinstatement of the non-social procedure. Similarly, except for the same two subjects, self audits increased from the A_1 procedure to parallel work, and then decreased during the second non-social procedure (A_2). Self audits appeared to increase over all conditions for Subject 7. For Subject 10, self audits increased from the initial non-social procedure to the cooperation procedure, but subsequent procedural changes had little effect.

Individual and cooperative methods of responding were under the control of the appropriate procedures except when two pairs (Subjects 1, 2, 9, and 10) responded individually for the first two sessions under the cooperation procedure (arrows on Figure 2). However, the response interactions during cooperation did not appear to be essential to the increase in self audits because their frequency was about the same during parallel work and cooperation (see Table 1). Rather, the addition of a coactor under a parallel work procedure appeared to be sufficient to bring about this increase.

The solid circles of Figure 3 show the coactor audits per problem for each session under each procedure. Subjects produced few illuminations of the coactor counter under the non-social procedures, but they usually produced between 0.25 and 1.0 per problem under the social procedures. Table 1, which gives the mean coactor audits per problem for

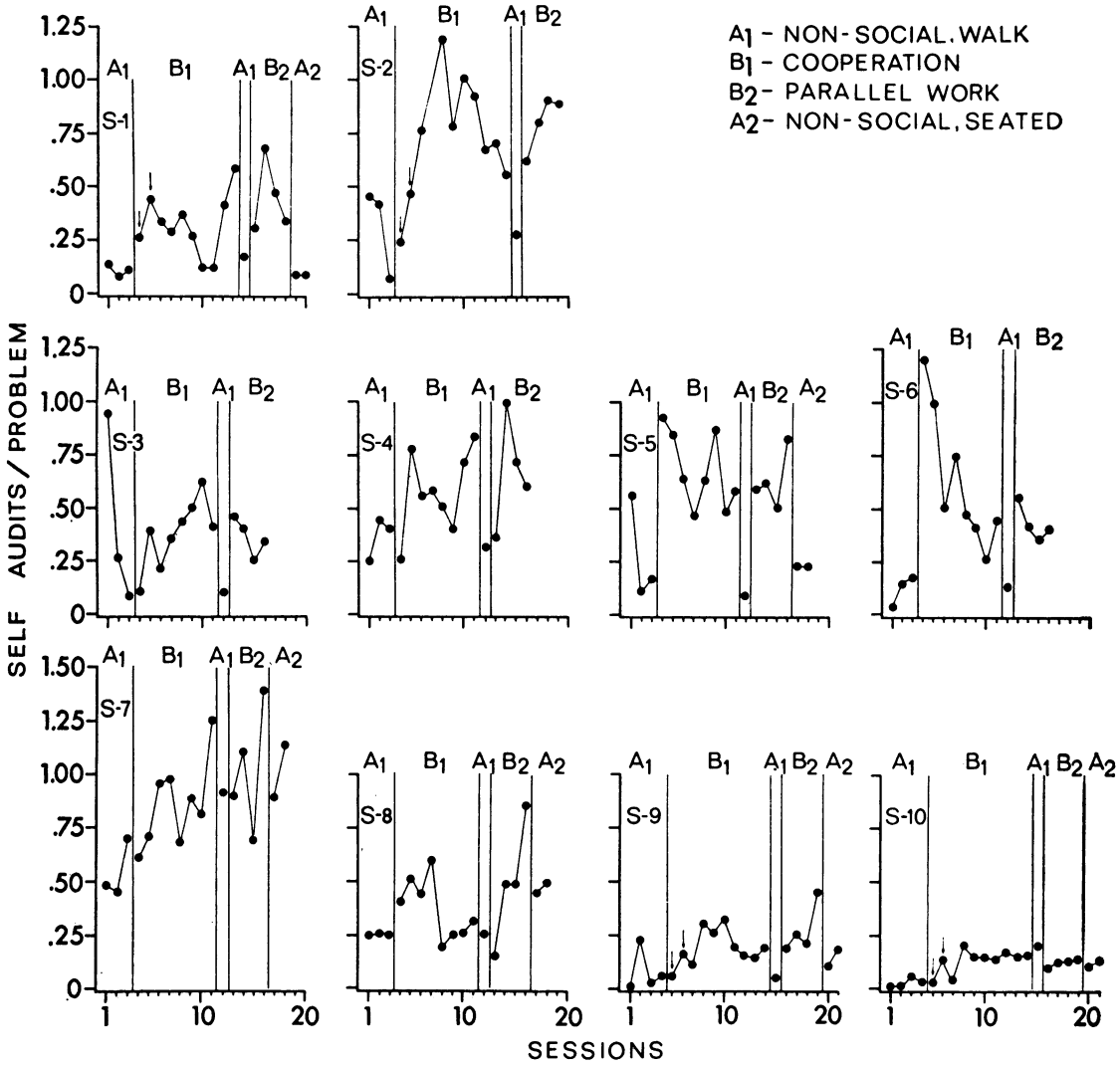

Fig. 2. Session-by-session plot of self audits per problem for each subject across all procedures. The arrows above points during the cooperation procedure indicate sessions during which the subject did not respond cooperatively.

each procedure, reveals that the mean number of illuminations of the coactor counter during the non-social procedures was almost always less than 10% of the number during the social procedures. These data indicate that the responses that illuminated the counters were maintained by the score on the counters, rather than the mere illumination of the counters.

Table 1 also reveals that subjects typically produced about the same number of self and coactor audits under the social procedures. Moreover, there was a close temporal relationship between self and coactor audits. At least 10 sec elapsed between the completions of consecutive problems (7.5 sec from the end of one problem to the start of the next and 3 to 4 sec to work a problem). If a subject produced a self audit after each problem he worked and a coactor audit after each problem the coactor worked, there would be at least 8 sec between self and coactor audits, since each illumination of an audit counter lasted from 0.5 sec to 2 sec (counter illuminations always lasted 2 sec for Subjects 9 and 10 and almost always 0.5 to 2 sec for Subjects 1 to 8 whose counters were illuminated as long as they kept the audit button depressed). Yet, not including Subject

Table 1

Mean Number of Audits per Problem for all Sessions Under Each Procedure.

	Self Audits					*Coactor Audits*					*Interpersonal Audits*				
Subjects	A_1	B_1	A_1	B_2	A_2	A_1	B_1	A_1	B_2	A_2	A_1	B_1	A_1	B_2	A_2
1	0.13	0.31	0.17	0.45	0.08	0	0.31	0.03	0.45	0.02	0	0.28	0.03	0.35	0.01
2	0.31	0.83	0.28	0.80		0.02	0.79	0.02	0.88		0.02	0.69	0.02	0.73	
3	0.17	0.38	0.11	0.36		0.03	0.39	0	0.42		0.02	0.36	0	0.33	
4	0.37	0.58	0.32	0.67		0.03	0.55	0.03	0.65		0.02	0.47	0	0.56	
5	0.14	0.68	0.09	0.63	0.23	0.01	0.92	0.04	0.82	0.02	0.01	0.43	0.04	0.30	0.02
6	0.12	0.61	0.13	0.43		0.02	0.56	0.02	0.40		0.01	0.50	0.02	0.33	
7	0.53	0.86	0.93	1.02	1.01	0.02	0.92	0.09	1.10	0.09	0.01	0.83	0.07	0.92	0.08
8	0.25	0.37	0.26	0.48	0.47	0	0.36	0	0.40	0.03	0	0.24	0	0.20	0.01
9	0.08	0.22	0.06	0.28	0.15	0	0.17	0.00	0.29	0	0	0	0	0.07	0
10	0.02	0.14	0.20	0.12	0.12	0	0.13	0	0.12	0.03	0	0.06	0	0.09	0
Mean	0.21	0.50	0.26	0.52	0.34	0.01	0.51	0.02	0.55	0.03	0.01	0.39	0.02	0.39	0.02

Key: A_1 Non-social, walk
B_1 Cooperation
B_2 Parallel work
A_2 Non-social, seated

Note. The table includes all sessions except the first two non-cooperative sessions under the cooperation procedure for Subjects 1, 2, 9, and 10, and the first session of the experiment that deviated largely (Figure 2) from subsequent non-social sessions for Subjects 3 and 5.

9, 76% of all self audits were within 5 sec of a coactor audit and 75% of all coactor audits were within 5 sec of a self audit. The range was between 52% (Subject 10) and 94% (Subject 3) for self audits, and between 44% (Subject 5) and 92% (Subject 3) for coactor audits. And, as Table 1 shows, subjects actually averaged only 0.5 audits per problem (about 0.5 self audits per self problem and 0.5 coactor audits per coactor problem). Only one subject averaged one audit per problem. Thus, when subjects produced audits, they typically produced both types instead of only one.

The temporal grouping of self and coactor audits indicated that it was reinforcing to have access to both scores within a brief time period. For this reason, an interpersonal audit was recorded whenever a self and a coactor audit occurred within 5 sec of each other. The number of interpersonal audits per problem was calculated by dividing the number of interpersonal audits for a given session by one-half of the total number of problems in that session. This division was comparable to that used in calculating rates of the other audits, since each subject received about one-half of the problems. A given self or coactor audit was counted in only one interpersonal audit. These interpersonal audits are plotted along with the coactor audits in Figure 3, which shows how the rate of interpersonal audits paralleled the rate of coactor audits.

Figure 4 shows the per cent of the total number of each type of audit during successive quarters of the session. The data are averaged over all sessions under a given procedure, with data from the two non-social procedures pooled. The number in the lower right corner of each graph gives the per cent difference from the first to the last half of the session; hence, positive differences indicate a per cent increase from the first to the second half of the session and negative differences indicate a decrease. The rates of all types of audits generally increased within sessions under all procedures. Neither the type of audit nor the procedure affected the rate of increase within sessions.

Illuminations of the self-audit counter that were designated as bursts ranged from 0 (Subjects 9 and 10) to 16% of the total (Subject 5) with an average of 5% for all 10 subjects. There was no difference in the number of bursts between the social and non-social conditions. The number of illuminations of the coactor counter that were bursts was 7% for the social procedures.

A subject could also gain access to the coactor's score by pressing his conference button and asking his partner how many points

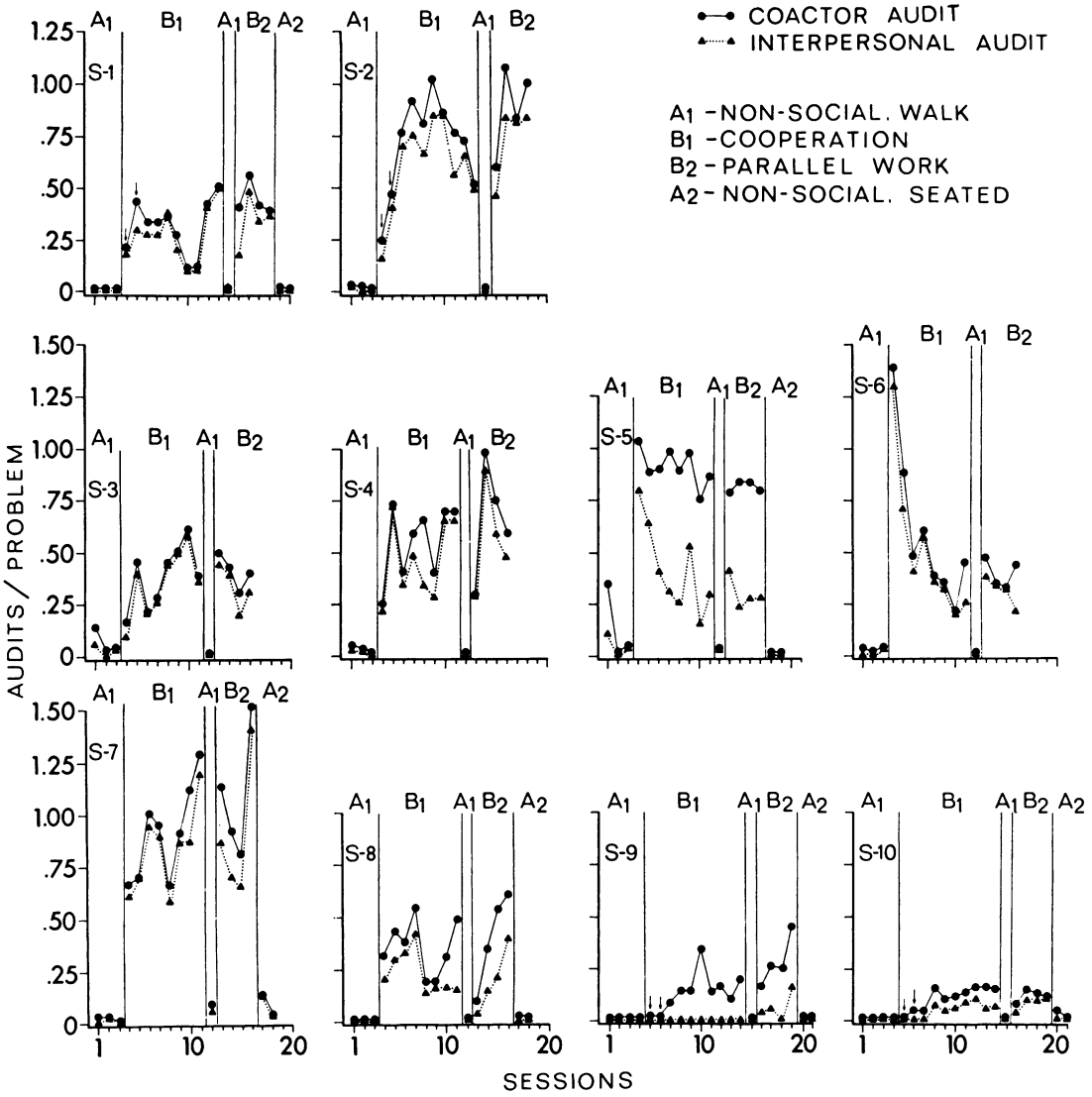

Fig. 3. Session-by-session plot of coactor (circles) and interpersonal (triangles) audits per problem for each subject across all procedures. The arrows above points during the cooperation procedure indicate sessions during which the subject did not respond cooperatively.

he had. However, most "conferences" consisted of school-related matters and kidding: only rarely did subjects inquire about scores. In fact, the conference buttons were not used often. Subjects rarely depressed their conference button for more than a total of 20 sec per session, and they averaged only three and six conferences per session for the cooperation and parallel work procedures, respectively.

There was little difference between procedures in the performance of the matching-to-sample task: all 10 subjects averaged at least 95% correct for the entire experiment, and no subject averaged less than 90% correct during any procedure. The mean percentages for each procedure averaged over all subjects were 96% for the first non-social procedure (A_1), 97% for cooperation, 97% for parallel work, and 98% for the second non-social procedure (A_2).

EXPERIMENT II

Experiment I showed that the increase in self audits from non-social to social procedures

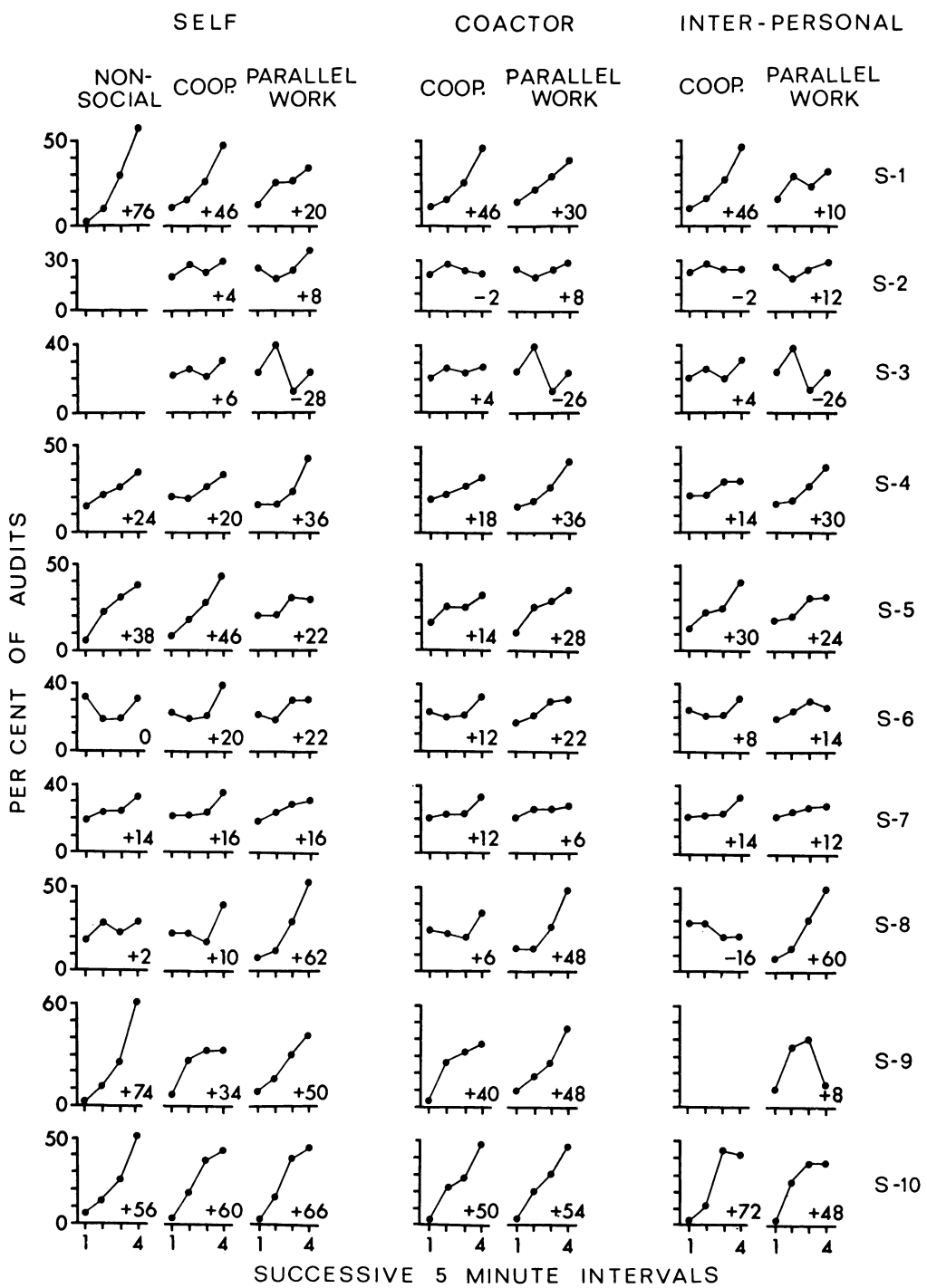

Fig. 4. Per cent of self, coactor, and interpersonal audits during successive quarters of the session for each subject under each procedure. Each graph includes all sessions under a given procedure, and the non-social graph for self audits includes all sessions under both non-social procedures. For the graphs with no data points, either the data were not available (Subjects 2 and 3, self audits under non-social procedures) or that type of audit did not occur under that procedure (Subject 9, interpersonal audits during cooperation). The number in each graph represents the percentage difference when the per cent in the first half of the session was subtracted from the per cent in the second half. Hence, positive percentages indicate a larger percentage of audits in the last half and a negative percentage indicates a larger percentage in the first half.

was about the same for parallel work and cooperation. Hence, the interaction of the subjects' responses during cooperation was not essential to the increase. Rather, the parallel work procedure, which involved only the addition of a coactor to the situation, was sufficient to produce the increase. Experiment II evaluated aspects of a coactor that might influence the rate of self-audit responses.

A change in behavior attributable to the addition of another individual to a situation will be designated as a "social stimulus effect" to distinguish it from a behavioral change that results from a response interaction with another individual or a "social interaction effect". Social facilitation, a well-known social stimulus effect, also involves increases in behavior during parallel work procedures (see review by Zajonc, 1965). Recent studies have shown that social facilitation effects depend upon the coactor doing something: the mere presence of another individual has little effect (*e.g.*, Hake and Laws, 1967; Hake, Powell, and Olsen, 1969). In Experiment I, the behavior of the coactor was accessible through the coactor's score on the coactor counter, as well as through visual and auditory observation of the coactor, the latter being the usual procedure in social facilitation studies. Although Experiment I did not demonstrate that a subject was comparing his own score with his coactor's, the frequent occurrence of interpersonal audits suggested that the coactor's score may have been the aspect of the coactor that produced the increase in self audits. To determine what aspect of the coactor was responsible for the increase in self audits, Experiment II compared the rate of self audits (1) when the subject worked alone, (2) during parallel work when a coactor was present and working, but his score was not accessible, and (3) during parallel work when a coactor was present, working, and his score was accessible.

Method

Subjects and Apparatus

The eight subjects, six males and two females all between 11 and 13 yr of age, were volunteers from local junior and senior high schools. The subjects were divided into four pairs, with the members of each pair being the same sex and about the same age. The apparatus was the same as in Experiment I.

Procedure

The matching-to-sample task for all procedures. The matching-to-sample task was essentially the same as in Experiment I, but with four changes. The first three changes were intended to ensure that a coactor audit response was the only way a subject could gain access to the coactor's score. First, the magnitude-of-reinforcement stimulus was presented only to the subject who could receive credit for working the problem. After 3 sec, the sample-operative stimulus on top of that subject's sample panel was illuminated: the subject then had 8 sec to work the problem. Because the magnitude-of-reinforcement stimulus lasted 3 sec before a problem could be worked, problems necessarily took longer in Experiment II. The second change was the addition of an ac buzzer that sounded after a correct matching-to-sample response. The buzzer was loud enough to mask the operation of the audit counters and thereby prevent auditory cues concerning the coactor's points. The third change was that the conference button was no longer operative. The fourth change was that self- and coactor-audit responses illuminated the appropriate counters for a constant duration of 2 sec, rather than for as long as the button was depressed.

Non-social procedures. There were two non-social procedures during which each member of a pair was tested alone with his sample panel next to his matching panel. To minimize any suggestion that the situation might eventually involve another subject, the coactor-audit counter was not labelled and could not be illuminated during the initial non-social procedure (A_1). During the second non-social procedure (A_2), the coactor audit counter was labelled and could be illuminated by pressing the coactor-audit button, but no score appeared on the counter. The self-audit counter was operative during both non-social procedures.

Social procedures with no coactor score. Under these procedures, subjects were tested together under the parallel work procedure, *i.e.*, each subject's sample panel was next to his own matching panel, but only the self-audit counter was operative. Under the first social procedure with no coactor score (B_1), the coactor-audit counter was not labelled and could not be illuminated. Under the second

procedure (B_2), the coactor-audit counter was labelled and could be illuminated, but no score appeared on the counter.

Social procedure with coactor score. This procedure (C) was the same as the B procedures except that both coactor and self-audit counters were labelled and were operative.

Social procedure with coactor score continuous. This procedure (D) was the same as the previous social procedure except that the coactor-audit counter was illuminated continuously so that a subject did not have to press the coactor-audit button to illuminate the coactor counter.

Experimental design. The sequence of procedures was A_1 B_1 C D A_2 for the first four subjects, and A_1 B_1 C B_2 A_2 for the last four subjects. A minimum of four sessions was required under each procedure, and each procedure was in effect until there were three consecutive sessions with no consistent and sizable increase or decrease in the number of self audits for each member of a pair. This criterion was almost always reached in four sessions.

Instructions. Before the training session, each subject was told that there would be two, 16-min sessions each day, pay periods would be weekly, and a bonus of 30¢ per day would be paid if the subject participated for five consecutive days. Each subject was then given instructions concerning how to work the matching-to-sample problems and provided with a training session in which he was allowed to work under the initial non-social procedure (A_1) until he correctly worked five consecutive problems. The instructions for Experiment II were similar to those of Experiment I except that (1) illumination of the audit counters required five button presses instead of one, (2) there was a 20¢ fine for talking during sessions, and (3) the instructions for the training and non-social sessions did not mention another subject.

After the first session of each day, subjects were escorted to a hallway outside the experimental room where they were instructed to wait about 5 min before the next session. There was no attempt to prevent subjects from talking with one another between or after sessions.

Data analysis. A counter illumination was designated as being a part of a burst and not counted if (1) a counter illumination of that same type had been counted as an audit in the preceding 10-sec period, and (2) if a counter illumination of the same type had occurred within the previous 3 sec even if more than 10 sec had elapsed since a counter illumination of that type had been counted as an audit. The latter requirement was included to prevent the counting of counter-illuminations that were part of a rapid succession of counter illuminations lasting longer than 10 sec.

Results

Figure 5 shows self audits per problem for the last three sessions under each procedure. The major finding was that Procedure C—the procedure in which the coactor was present, working, and his score accessible—resulted in the most audits. Procedure C resulted in more self audits than the initial non-social procedure (A_1) for all eight subjects, and more than the second non-social procedure (A_2) for six of the eight subjects. There was little difference between the C and A_2 procedures for two of the subjects (Subjects 14 and 18). Procedure C also resulted in more self audits than Procedure B, the procedure in which the coactor was present and working but his score was not accessible. This was the case for seven of the eight comparisons of C with B_1, and for all four comparisons of C with B_2. Procedure D was similar to Procedure C except that the coactor audit counter was continuously illuminated. With the exception of Subject 13, the number of self audits for the four subjects tested under Procedure D was similar to that reached by these subjects under Procedure C.

The mere presence of a second subject working, Procedure B, also appeared to increase self audits, since there were more self audits under the B procedures than under the non-social procedures. The initial B procedure (B_1) resulted in more self audits than the initial non-social procedure (A_1) for seven of the eight subjects, and the B_2 procedure resulted in more audits than the A_2 procedure for three of the four subjects that were tested under both procedures.

However, the coactor's score had a greater effect than the mere presence of the coactor. This can be seen by comparing the difference between A_1 and B_1 with the difference between B_1 and C, and the difference between A_2 and B_2 with the difference between B_2 and C. A difference between A and B in favor of B shows the effect of the presence of the coactor,

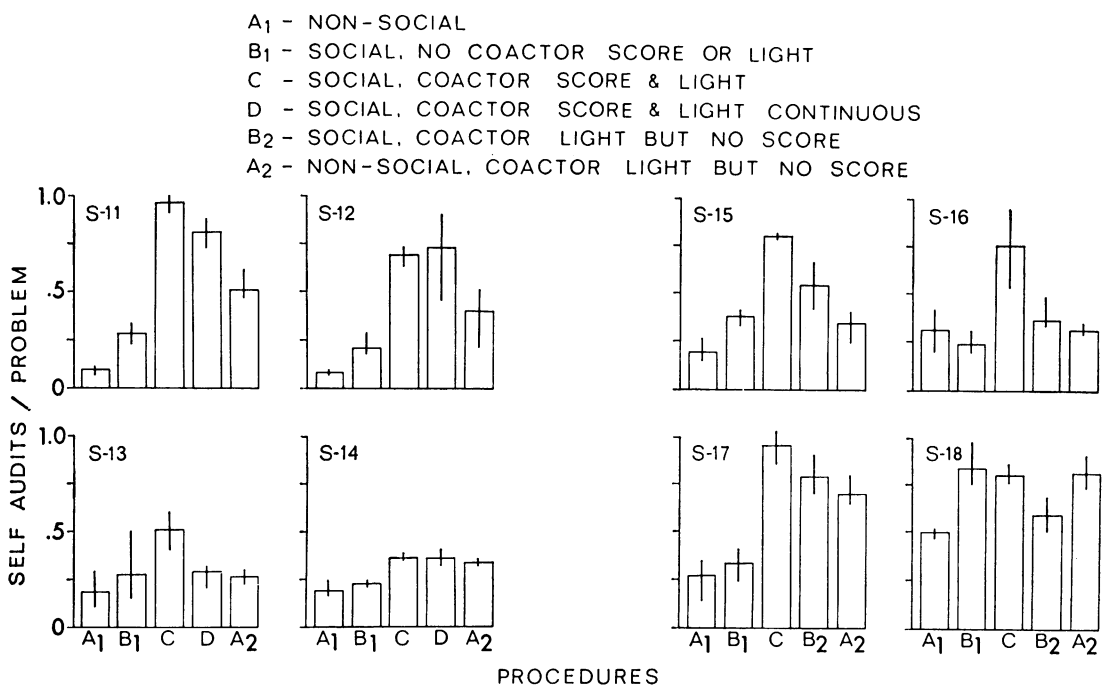

Fig. 5. The mean number of self audits per problem for each subject under each procedure of Experiment II. Each bar is the mean of the last three sessions under a given procedure, and the line through the bar shows the range of the last three sessions.

while a difference from B to C in favor of C shows the effect of the coactor's score. Of the 12 possible comparisons, 10 showed a greater difference between B and C than between A and B. Subject 18 accounted for both exceptions.

Comparisons of A_1 with A_2 and B_1 with B_2 reveal that the second testing on the A and B procedures generally resulted in more audits. The present data do not indicate the factors responsible for this increase, *i.e.*, nothing else to do, a gradual increase over time, or the light on the coactor-audit counter. However, this trend cannot account for the major effects, since the relative level of self audits was the same for the various procedures for the ascending (A to C) and descending (C to A) functions.

Since the magnitude-of-reinforcement stimulus for a given problem was presented only to the subject who could work that problem, subjects had no way of knowing how much the coactor could earn on a given problem. This relative absence of information concerning the point value of the coactor's problems, as compared to their own, was probably the reason that there were more coactor audits than self audits per problem under the C procedure. The mean number of coactor audits per problem was 0.88 with a range of 0.54 (Subject 15) to 1.08 (Subject 18), while the mean number of self audits per problem was 0.73 with a range of 0.36 (Subject 14) to 0.96 (Subjects 11 and 17).

As in Experiment I, there was a temporal relationship between self and coactor audits. At least 13 sec elapsed between the completion of consecutive problems in Experiment II (7.5 sec from the end of one problem to the start of the next, 3-sec magnitude-of-reinforcement stimulus, and 3 to 4 sec to work the problem). If a subject produced a self audit after each of his matching problems and a coactor audit after each coactor problem, there would be at least 11 sec between self and coactor audits, since counters were always illuminated for 2 sec. Yet, for all eight subjects, an average of 70% of the self audits were within 5 sec of a coactor audit. The average number of these interpersonal audits per problem was 0.48 with a range of 0.30 (Subject 14) to 0.64 (Subject 18).

Analysis of the illuminations of the coactor counter under the A_2 and B_2 procedures,

where the coactor's score was not available, reveal that the counter light alone could not account for the audits under C procedure where the coactor's score was available. During the A_2 and B_2 procedures, illuminations of the coactor counter dropped to 0.13 per problem, and illuminations of both self and coactor counters within 5 sec dropped to 0.04 per problem.

As in Experiment I, the rate of self audits increased within sessions for at least three-fourths of the subjects under all conditions. And, when the coactor's score was accessible in Procedure C, coactor and interpersonal audits also increased within sessions for most of the subjects.

The percentage of illuminations of the self-audit counter that were designated as bursts increased from Experiment I (5%) to Experiment II (12%). This was due in large part to the increase from 5 sec in Experiment I to 10 sec in Experiment II in the time that had to elapse after one illumination before another was counted.

The eight subjects averaged 97 or 98% correct on the matching-to-sample problems under all procedures with no subject averaging less than 90% correct. The average number of problems per session was 29 for the non-social procedures and 33 for the social procedures.

The fine for talking during sessions was never levied.

GENERAL DISCUSSION

Considerable research has attempted to determine the effects of self and coactor scores upon subsequent performances such as school work, cooperative behavior, and self-reward behaviors. The present study attempted to measure characteristics of the responses that allow access to such scores, and to discover factors in social situations that affect these audit responses. In previous studies, self and coactor scores have been provided independently of the subject's responses, or in conjunction with a response that already had another consequence, such as the completion of a task. In the present study, (1) access to self and coactor scores was arranged to be dependent upon the subject's responses, and (2) these audit responses were arranged to have no consequence other than access to self or coactor scores. The audit responses, button-press responses that illuminated counters, appeared to meet these objectives in that (1) subjects did emit the audit responses rather than rely on other sources of information, and (2) the audit responses dropped to zero or near-zero levels when they did not result in access to a score, thereby indicating that the score on the counter was the major reinforcer for audit responses.

Experiment I showed that the addition of a coactor to a non-social situation increased self as well as coactor audits. The increases could not be attributed to any special interaction between the responses of the two subjects to produce reinforcement: both types of audits occurred at about the same rates during cooperation, where there was such an interaction, and during parallel work where there was no such interaction. The finding that these increases occurred upon changing from the non-social procedure to the parallel work procedure indicated that the addition of another individual engaged in the same kind of work was sufficient to produce the increases. This was further indicated in Experiment II, where similar increases occurred without any history of cooperative responding. Behavioral changes attributable to the addition of another individual to a situation were designated as "social stimulus effects" to distinguish them from behavioral changes that result from response interaction with another person or "social interaction effects".

It is not surprising that the introduction of a coactor into a non-social situation increased coactor audits, since those audits now allowed access to information about a new stimulus. But why should the introduction of a coactor, whose behavior affects only his own reinforcers, produce an increase in self audits? This question was approached by asking what aspect of the coactor was responsible for the increase in self audits. Although Experiment I did not demonstrate that a subject was comparing his own score with his coactor's, the frequent occurrence of interpersonal audits in Experiment I suggested that the score of the coactor may have been an important factor. The results of Experiment II supported this notion: relative to a non-social procedure, self audits increased more during a parallel work procedure when the coactor's score was accessible than when it was not accessible. Simply, the presence and score of a coactor produced

a larger increase than just the presence of a coactor. Although the addition of a coactor was accompanied by an increase in self audits, it is not certain that the increase can be attributed solely to the presence of a coactor. Some information on the latter's score might have been available to the subjects since (1) subjects could question one another between the sessions about their scores and (2) the coactor's behavior may have provided some stimuli concerning his score. The procedure in which the coactor's score was not accessible was similar to that which had been effective in most studies of social stimulus effects. In social facilitation studies, for instance, the presence of a non-behaving individual has typically had little effect, but the presence of a coactor engaged in the same task has typically been sufficient to produce the social facilitation effect (*e.g.*, Hake and Laws, 1967; Hake *et al.*, 1969). The present results appear to extend previous findings by indicating that, at least with human subjects and the self-audit response, social stimulus effects may be increased by providing a score on the coactor's performance. In fact, it is possible, particularly in the case of human subjects, that stimuli concerning the coactor's progress are essential in producing all social facilitation effects, even in social facilitation procedures where the score of the coactor is not provided and the behavior of the coactor provides the only stimuli concerning the coactor's progress.

The major generalization of this study is that the availability of a coactor's score increases self audits. It would appear that an individual's own score is a reinforcer and that access to a coactor's score creates conditions under which an individual's own score is more reinforcing. If this is the case, and if the interpersonal audit indicated that subjects were comparing scores, the size and direction of the difference between self and coactor scores could be other factors affecting the rate of self audits. Thus, the size and direction of the difference could affect the extent to which one's own score is reinforcing. For example, a large difference in favor of the subject would be expected to be more reinforcing than a large difference in favor of the coactor. Also, the drive operations for audit responses would be expected to be greatest when the scores of the two individuals were about even, as opposed to when a given subject was either far ahead or far behind (also see Festinger, 1954). It will be recalled that in the present experiments, the number of problems and the point values attached to problems were assigned to the two subjects in a mixed order but on a 50-50 basis such that there were deviations from an equal distribution of points, but the deviations were neither large nor consistent. Studies in which a subject was consistently ahead, behind, or even with his coactor would be necessary to determine whether and to what extent the increase in self audits that resulted upon the introduction of a coactor and his score was dependent upon relative score. The results of such an experiment could indicate whether or not the subjects were in fact comparing scores and could clarify the nature of the reinforcer maintaining audit responses.

Audit responses were initially observed by the authors during a cooperation procedure when subjects asked one another about their scores (Hake and Vukelich, 1973). In that study, cooperation did not appear to be a unitary social process; other social phenomena such as audit responses and leadership responses were observed during cooperation. However, the most frequent approach to the study of cooperation has been to manipulate the contingencies applied to the cooperative behavior itself: cooperative responses have been reinforced, extinguished, punished, and brought under stimulus control. The observation of correlated social phenomena suggests that another approach to the study of cooperation is to measure the effects of these correlated social phenomena upon cooperation. If the degree of cooperation is defined in terms of the extent of the correspondence between the number of cooperative responses of two individuals (Hake and Vukelich, 1972), audits could have a large effect upon cooperation. Audit responses are one way that subjects can keep track of their relative score and learn whether or not their partner is responding in a reciprocal manner. In the study of Hake and Vukelich (1973), subjects were free to make cooperative responses at any rate; cooperation increased the correspondence of the number of responses of the two subjects over that observed during a parallel work procedure where the subjects were also free to respond at any rate. However, during cooperation, some subjects underestimated their score when questioned by their partner. Such inac-

curacies in the audit system may have been responsible for the correspondence between scores being considerably less than 100%. It would be of practical as well as theoretical interest to determine the extent to which an accurate audit system, such as the one in the present study, produces a higher degree of correspondence or reciprocity than an audit system that relies on the verbal reports of the participants. Such a study would be one example of the correlated-social-phenomena approach to the study of cooperation.

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